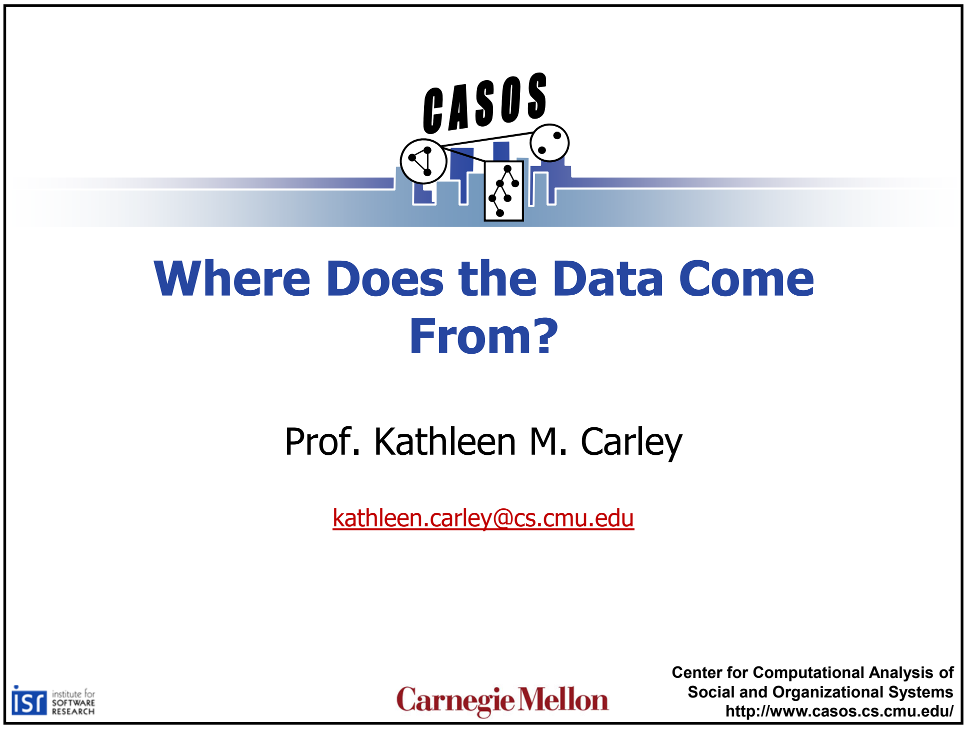


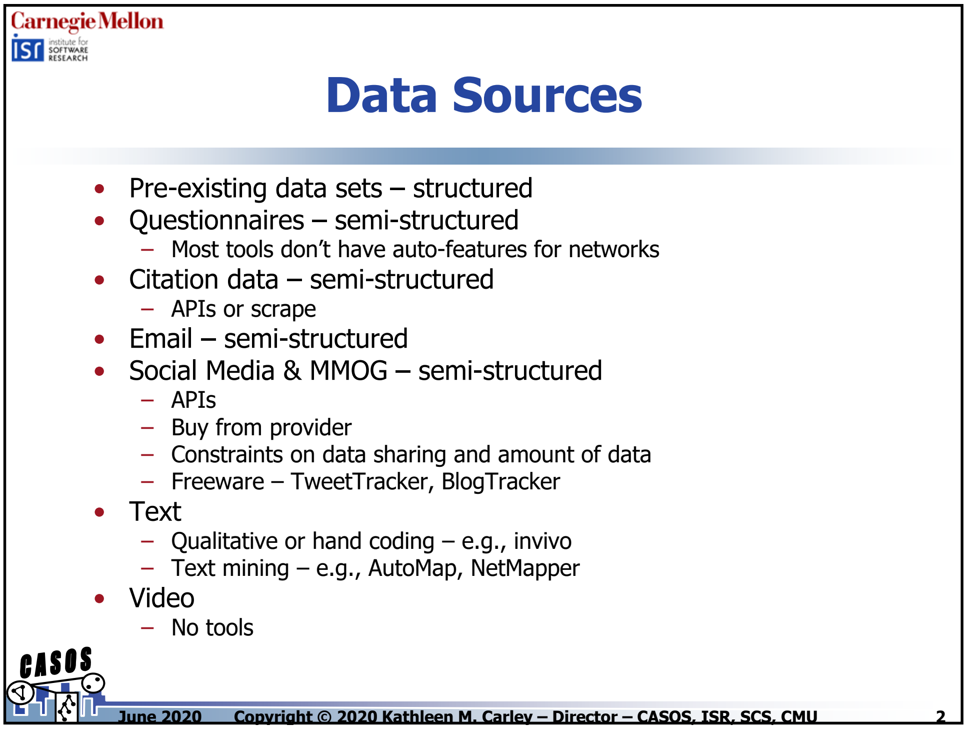
Where Does the Data Come From?

Prof. Kathleen M. Carley

kathleen.carley@cs.cmu.edu

Carnegie Mellon

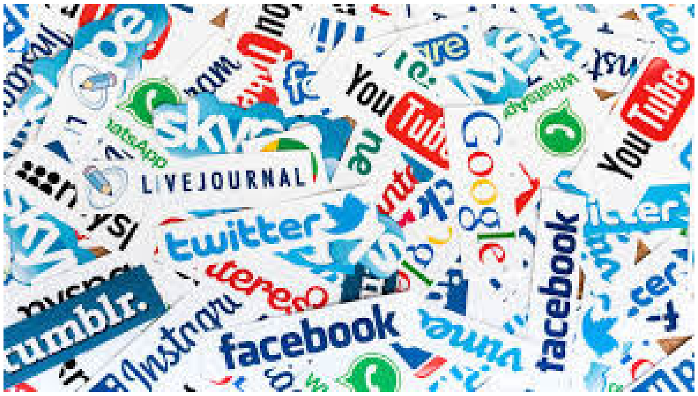
Center for Computational Analysis of
Social and Organizational Systems
http://www.casos.cs.cmu.edu/



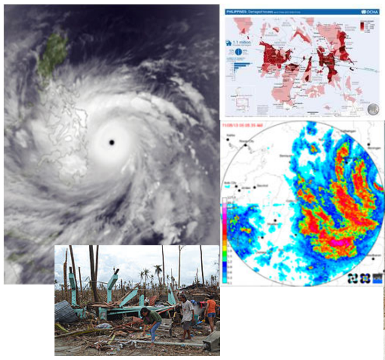
Data Sources

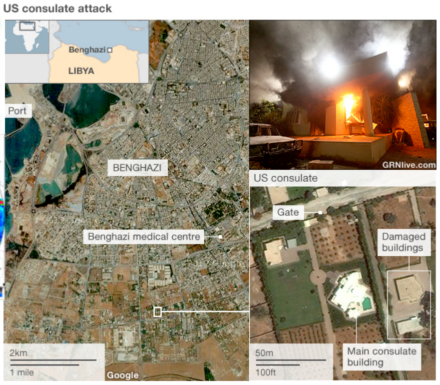
- Pre-existing data sets – structured
- Questionnaires – semi-structured
  - Most tools don’t have auto-features for networks
- Citation data – semi-structured
  - APIs or scrape
- Email – semi-structured
- Social Media & MMOG – semi-structured
  - APIs
  - Buy from provider
  - Constraints on data sharing and amount of data
  - Freeware – TweetTracker, BlogTracker
- Text
  - Qualitative or hand coding – e.g., invivo
  - Text mining – e.g., AutoMap, NetMapper
- Video
  - No tools

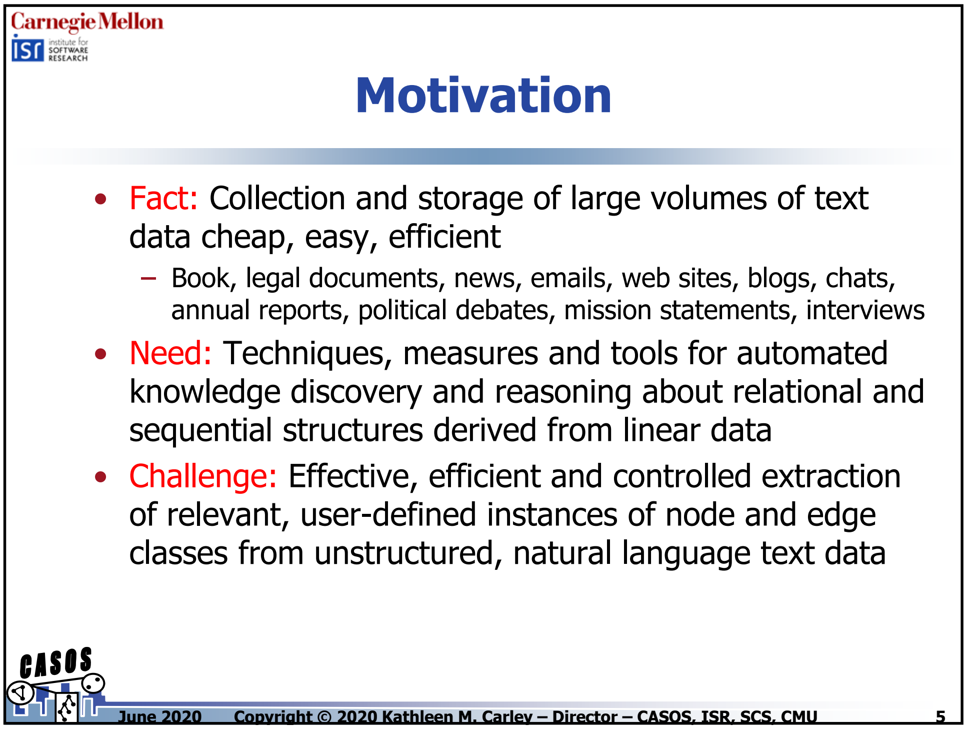
Many Types of Social Media



Many Situations Where Analysts Need to Examine Open Source Data







Motivation

- Fact: Collection and storage of large volumes of text data cheap, easy, efficient
  - Book, legal documents, news, emails, web sites, blogs, chats, annual reports, political debates, mission statements, interviews
- Need: Techniques, measures and tools for automated knowledge discovery and reasoning about relational and sequential structures derived from linear data
- Challenge: Effective, efficient and controlled extraction of relevant, user-defined instances of node and edge classes from unstructured, natural language text data

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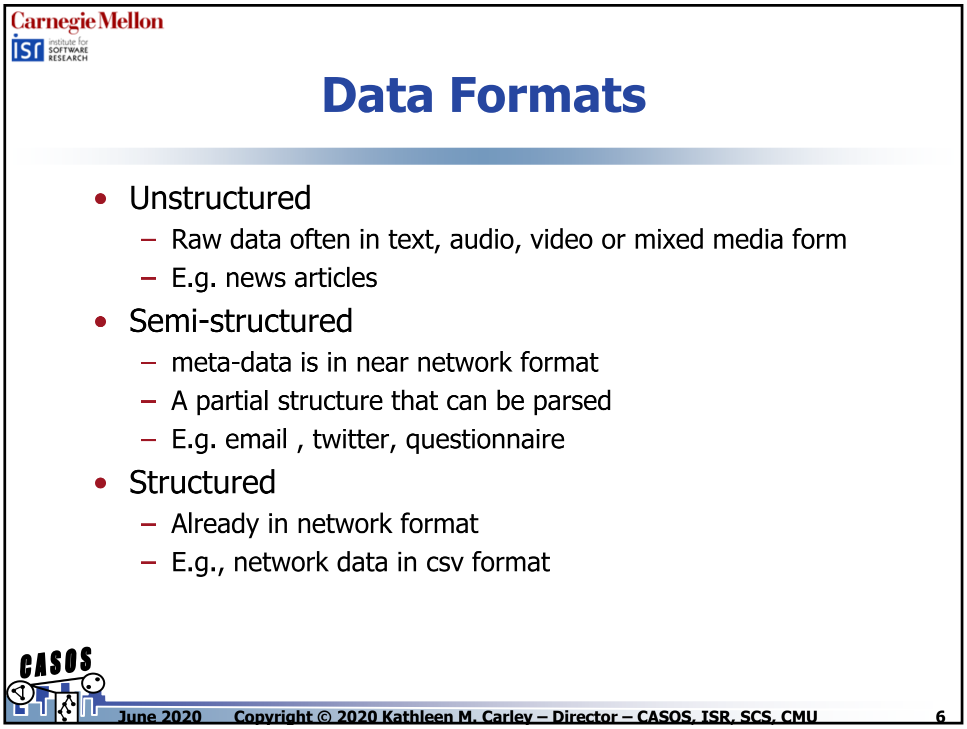

Data Formats

- Unstructured
  - Raw data often in text, audio, video or mixed media form
  - E.g. news articles
- Semi-structured
  - meta-data is in near network format
  - A partial structure that can be parsed
  - E.g. email , twitter, questionnaire
- Structured
  - Already in network format
  - E.g., network data in csv format

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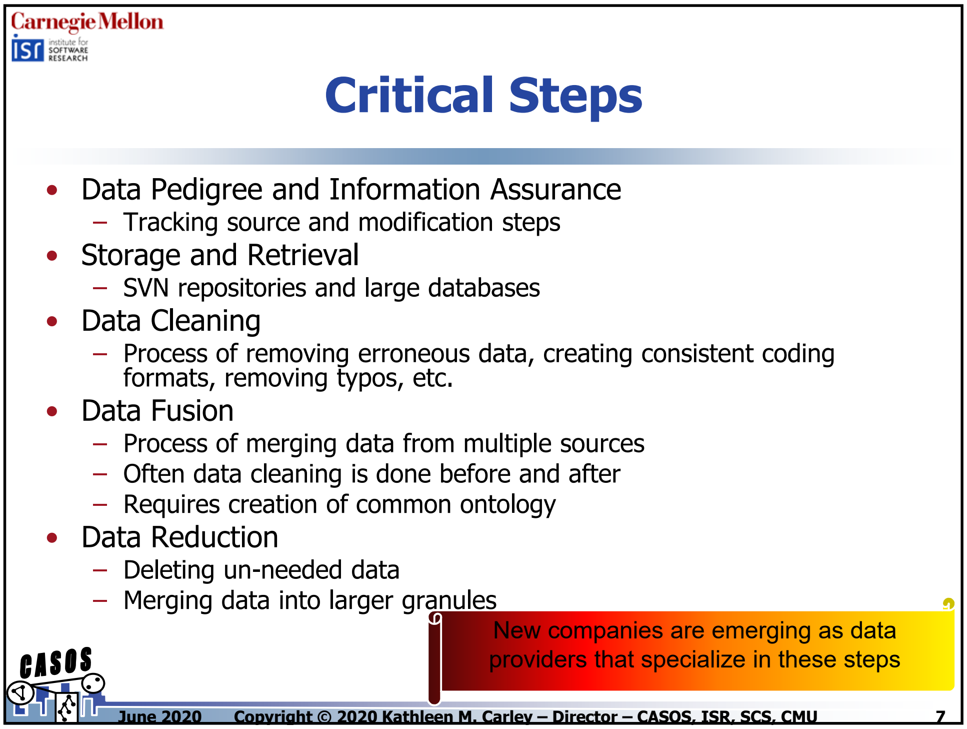

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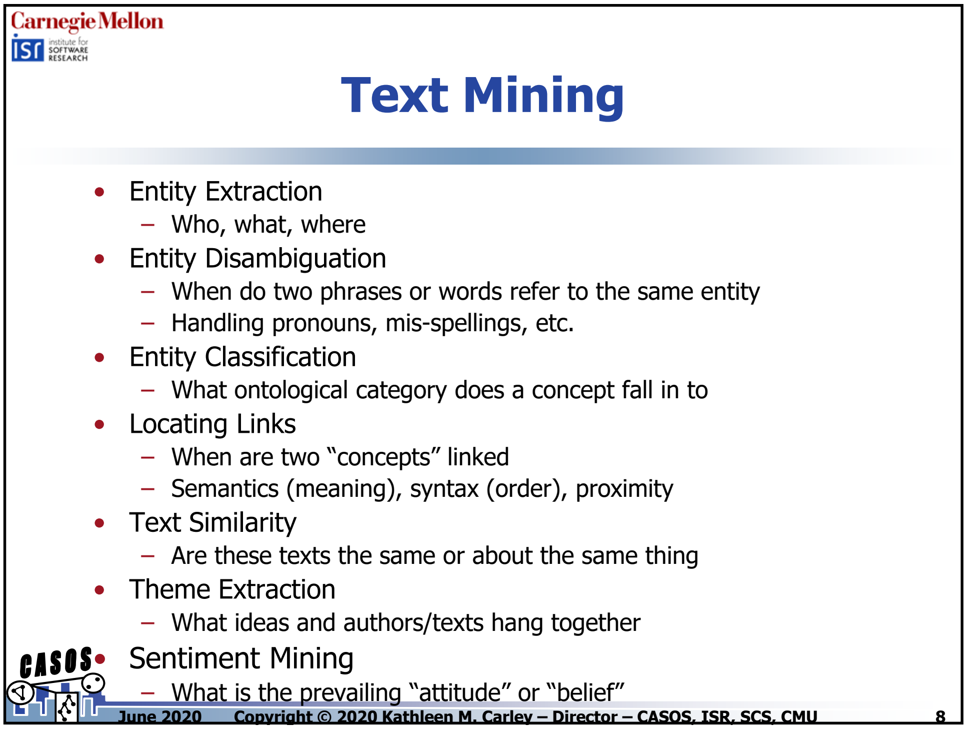
Critical Steps

- Data Pedigree and Information Assurance
  - Tracking source and modification steps
- Storage and Retrieval
  - SVN repositories and large databases
- Data Cleaning
  - Process of removing erroneous data, creating consistent coding formats, removing typos, etc.
- Data Fusion
  - Process of merging data from multiple sources
  - Often data cleaning is done before and after
  - Requires creation of common ontology
- Data Reduction
  - Deleting un-needed data
  - Merging data into larger granules

New companies are emerging as data providers that specialize in these steps



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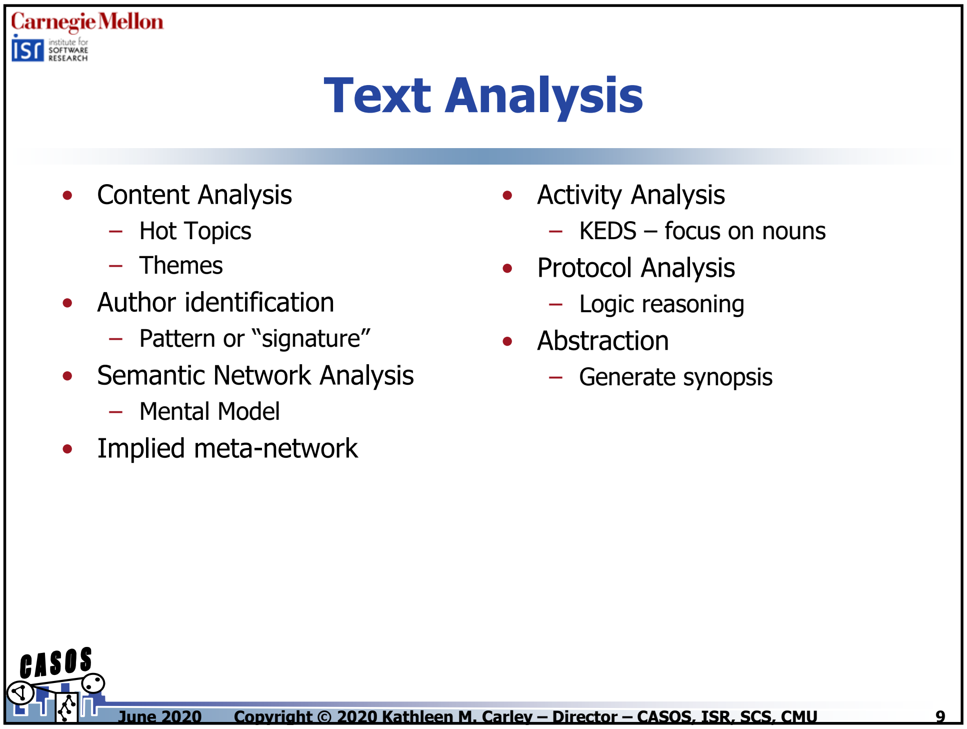
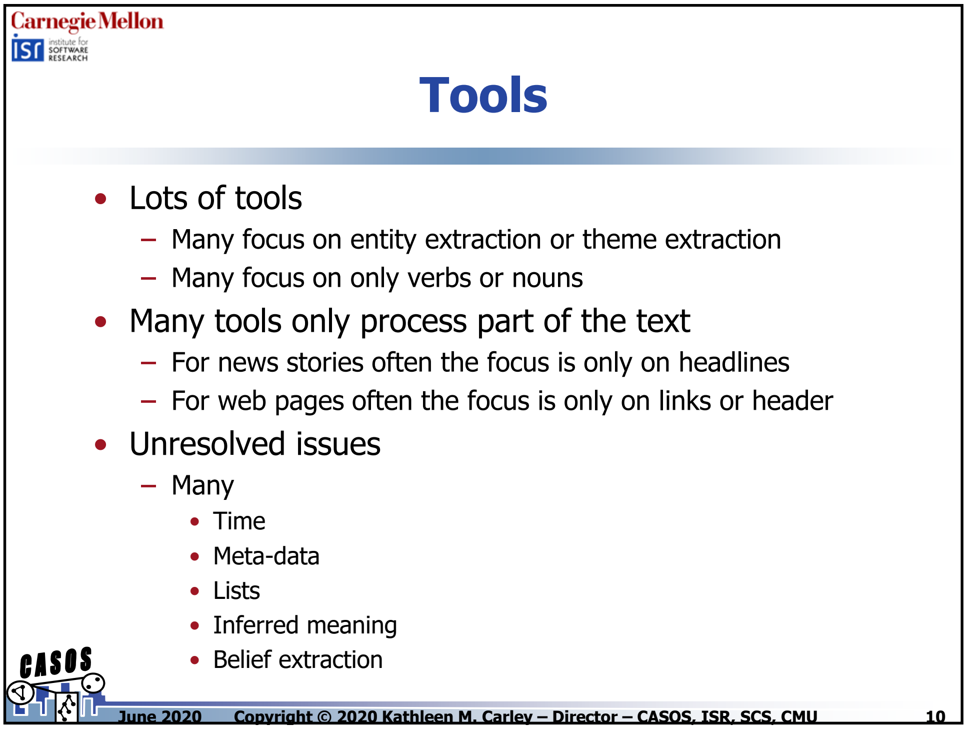
Text Mining

- Entity Extraction
  - Who, what, where
- Entity Disambiguation
  - When do two phrases or words refer to the same entity
  - Handling pronouns, mis-spellings, etc.
- Entity Classification
  - What ontological category does a concept fall in to
- Locating Links
  - When are two “concepts” linked
  - Semantics (meaning), syntax (order), proximity
- Text Similarity
  - Are these texts the same or about the same thing
- Theme Extraction
  - What ideas and authors/texts hang together
- Sentiment Mining
  - What is the prevailing “attitude” or “belief”



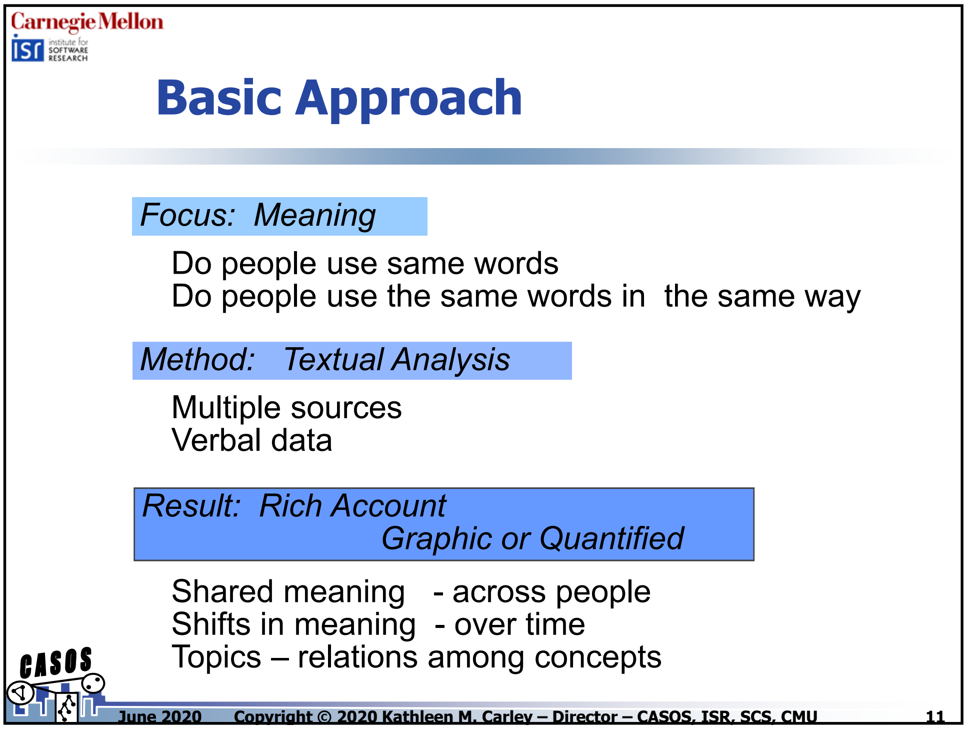
Text Analysis

- Content Analysis
  - Hot Topics
  - Themes
- Author identification
  - Pattern or "signature"
- Semantic Network Analysis
  - Mental Model
- Implied meta-network
- Activity Analysis
  - KEDS – focus on nouns
- Protocol Analysis
  - Logic reasoning
- Abstraction
  - Generate synopsis



Tools

- Lots of tools
  - Many focus on entity extraction or theme extraction
  - Many focus on only verbs or nouns
- Many tools only process part of the text
  - For news stories often the focus is only on headlines
  - For web pages often the focus is only on links or header
- Unresolved issues
  - Many
    - Time
    - Meta-data
    - Lists
    - Inferred meaning
    - Belief extraction



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Basic Approach

Focus: Meaning

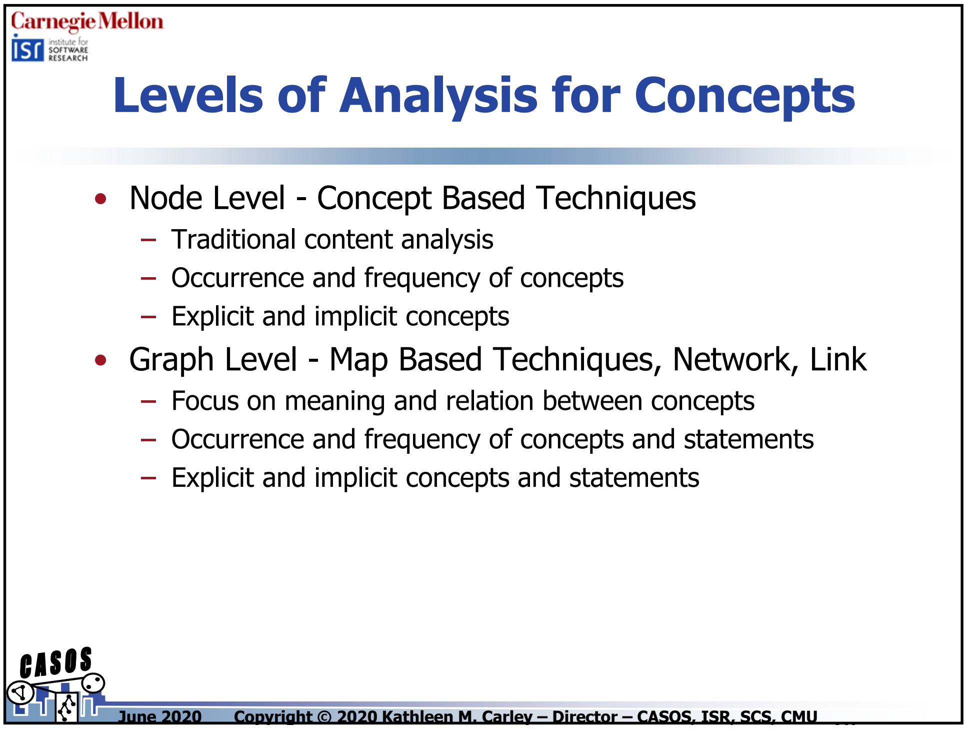
Do people use same words
Do people use the same words in the same way

Method: Textual Analysis

Multiple sources
Verbal data

Result: Rich Account
Graphic or Quantified

Shared meaning - across people
Shifts in meaning - over time
Topics – relations among concepts



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Levels of Analysis for Concepts

- Node Level - Concept Based Techniques
  - Traditional content analysis
  - Occurrence and frequency of concepts
  - Explicit and implicit concepts
- Graph Level - Map Based Techniques, Network, Link
  - Focus on meaning and relation between concepts
  - Occurrence and frequency of concepts and statements
  - Explicit and implicit concepts and statements

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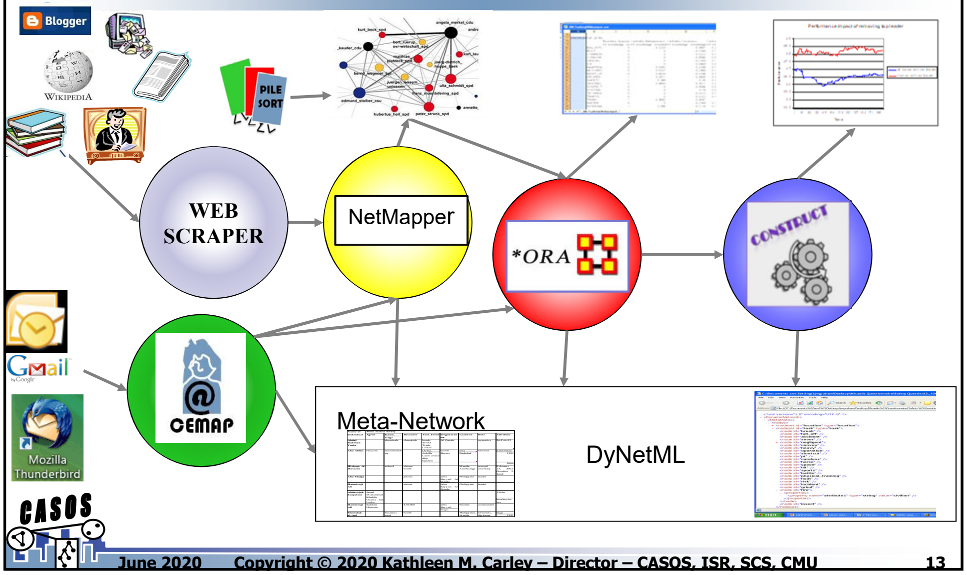
Tools and Workflows Exist and Are Improving for extracting, analyzing, forecasting, …



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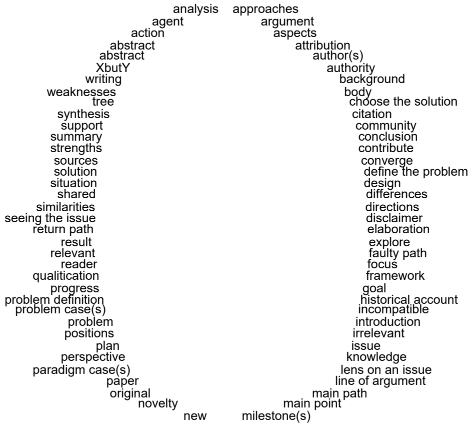
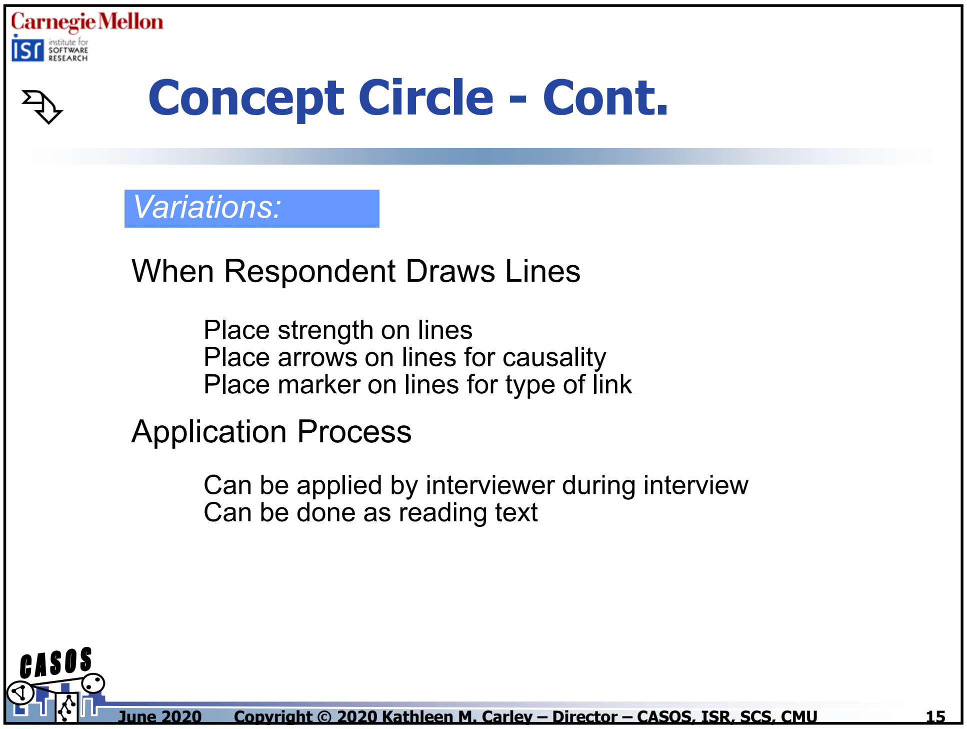
Concept Circle - Example

Clustering Task # 2: April 26, 1989 **Name** ______________________

Directions: These words have been mentioned in class lectures over the past semester. Please draw a line between pairs of words which you believe should be connected. It is important that all connections that you intend to make be clear and easy to see. Please do not draw so many lines on any one worksheet that you cannot easily see how you've connected those words.



Palmquist, Kaufer, Carley Learning to Write Study 1989



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Concept Circle - Cont.

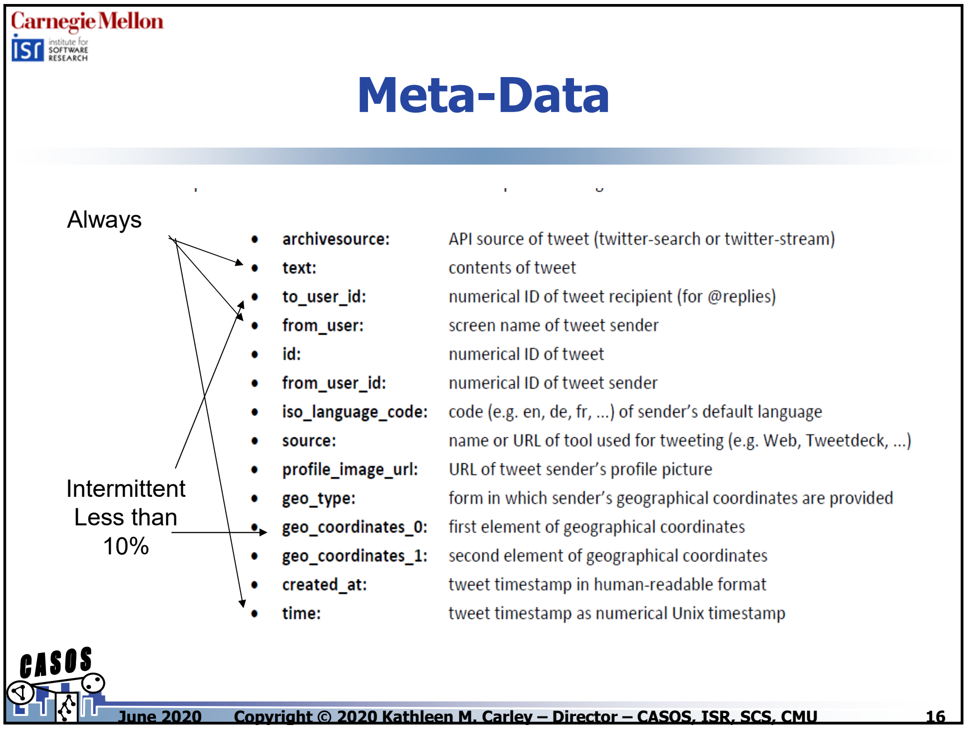
Variations:

When Respondent Draws Lines

Place strength on lines
Place arrows on lines for causality
Place marker on lines for type of link

Application Process

Can be applied by interviewer during interview
Can be done as reading text



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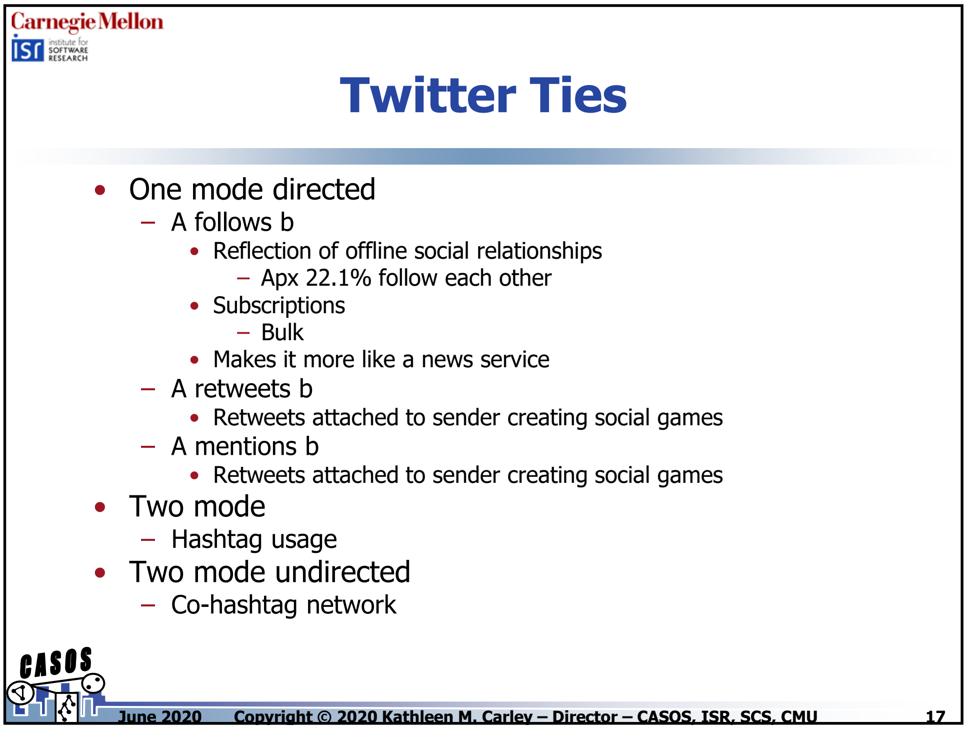
Meta-Data

Always

Intermittent
Less than
10%

archivesource:	API source of tweet (twitter-search or twitter-stream)
text:	contents of tweet
to_user_id:	numerical ID of tweet recipient (for @replies)
from_user:	screen name of tweet sender
id:	numerical ID of tweet
from_user_id:	numerical ID of tweet sender
iso_language_code:	code (e.g. en, de, fr, ...) of sender's default language
source:	name or URL of tool used for tweeting (e.g. Web, Tweetdeck, ...)
profile_image_url:	URL of tweet sender's profile picture
geo_type:	form in which sender's geographical coordinates are provided
geo_coordinates_0:	first element of geographical coordinates
geo_coordinates_1:	second element of geographical coordinates
created_at:	tweet timestamp in human-readable format
time:	tweet timestamp as numerical Unix timestamp



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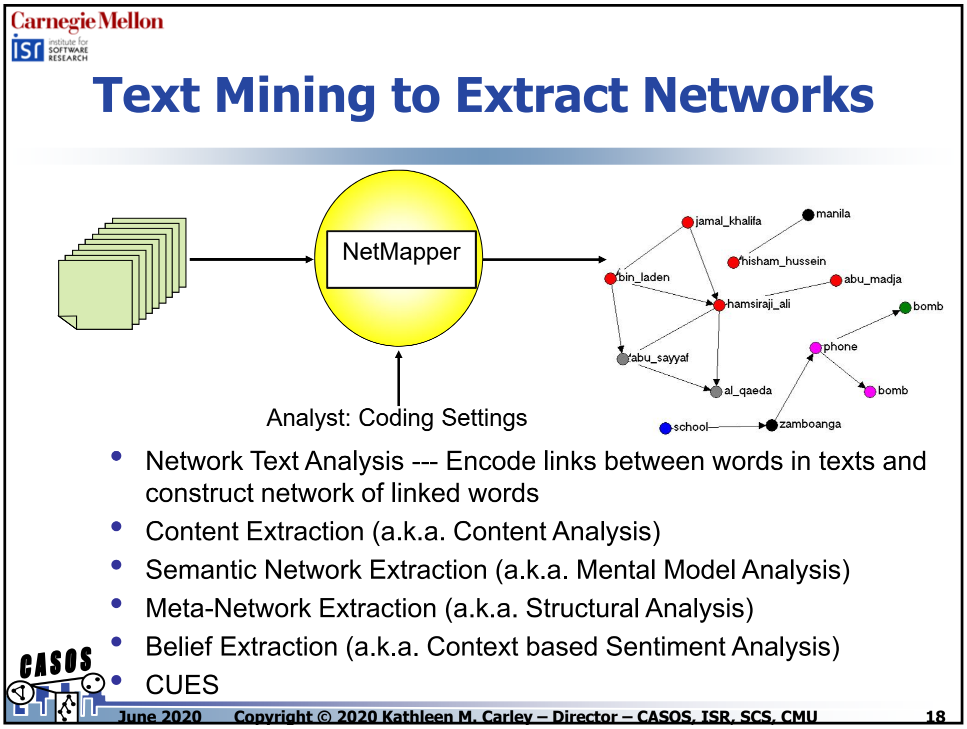
Twitter Ties

- One mode directed
  - A follows b
    - Reflection of offline social relationships
      - Apx 22.1% follow each other
    - Subscriptions
      - Bulk
    - Makes it more like a news service
  - A retweets b
    - Retweets attached to sender creating social games
  - A mentions b
    - Retweets attached to sender creating social games
- Two mode
  - Hashtag usage
- Two mode undirected
  - Co-hashtag network



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Text Mining to Extract Networks

- Network Text Analysis --- Encode links between words in texts and construct network of linked words
- Content Extraction (a.k.a. Content Analysis)
- Semantic Network Extraction (a.k.a. Mental Model Analysis)
- Meta-Network Extraction (a.k.a. Structural Analysis)
- Belief Extraction (a.k.a. Context based Sentiment Analysis)
- CUES